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AN EVALUATION OF PROPOSED ACOUSTIC
TREATMENTS FOR THE NASA LaRC 4 x 7
METER WIND TUNNEL

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1 INTRODUCTION

Current NASA missions in aeroacoustics at Langley Research Center (LaRC) emphasize research in rotorcraft and advanced propellers. Performance of this research requires a wind-tunnel facility capable of supporting large scale model tests of powered rotors and propellers. Based on the present state-of-the-art in the understanding of rotor noise generation mechanisms and associated scaling procedures, it appears to be generally held that a model test of the order of one-sixth of full size is the smallest scale from which accurate full scale data may be inferred.

Needless to say, one-sixth scale rotor testing implies the use of a very large wind-tunnel. Large wind-tunnels suitable for acoustic tests, however, are a resource which is presently non-existent even on a national level in the United States. Construction of a new acoustic wind-tunnel for large-scale powered tests is a multi-year effort representing several tens of millions of dollars.

The obvious alternative to new construction is modification of an existing facility, preferably one located at NASA-Langley Research Center.

The 4 x 7 meter (V/STOL) tunnel (Figure 1) is an existing facility at LaRC which has, and is presently being used for acoustic measurements of rotorcraft scale models. This tunnel is also large enough to support the desired one-sixth scale testing. However, since this facility was not originally intended for acoustic research, substantial study has been required to assess its capability, even with extensive modification, to act as a comprehensive aero-acoustic test facility.

The principal part of this study has been performed by Bolt, Berarek and Newman (BBN). Their activity is documented in Reference 1 and supplements three other studies also performed by them, on the same facility over the past thirteen years.⁽²⁻⁴⁾

Augmenting the BBN studies in this regard are measurements of acoustical characteristics of the tunnel and rotorcraft noise data which have been made over the years (for example see References 5 through 7) by investigators performing model studies in the facility.

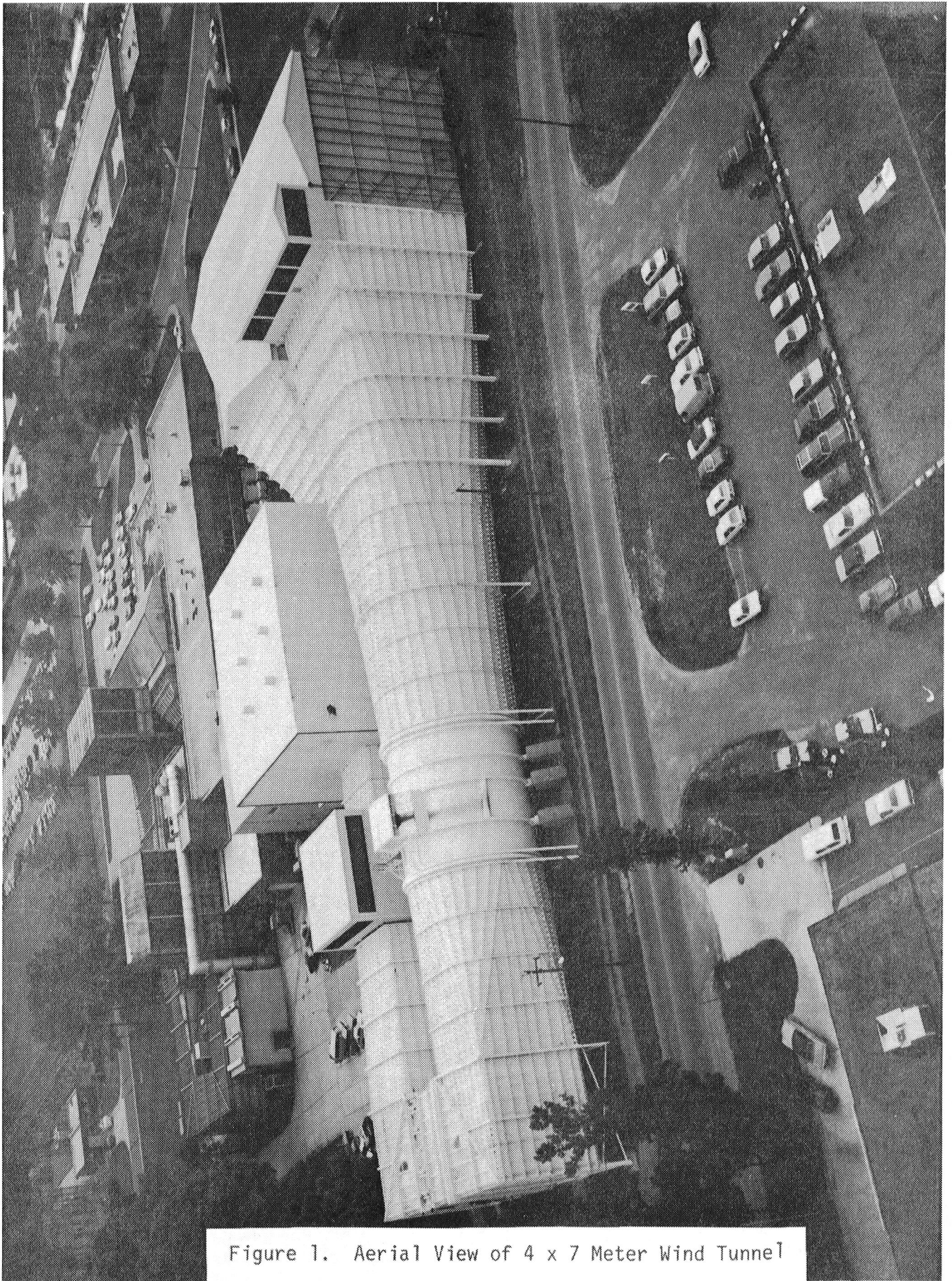


Figure 1. Aerial View of 4 x 7 Meter Wind Tunnel

The present report presents a brief critique of the work performed under a NASA contract by BBN in their most recent study ⁽¹⁾ and evaluates the various acoustic treatment options for the 4 x 7 m tunnel proposed there.

As a result of this critique, a key assumption made by BBN is questioned and supporting analyses are given to validate this point of view.

2 EVALUATION OF PROPOSED ACOUSTIC TREATMENTS FOR THE 4 x 7 M TUNNEL

2.1 Summary of BBN Recommendations

In Reference 1, BBN present three approaches* to background noise reduction in the 4 x 7 m tunnel. These approaches are summarized in Table 1, and represent the distillation of a substantial measurement and analysis effort. The three approaches represent two separate philosophies for achieving the NASA noise reduction goal:

- o Attenuate the noise from acoustic sources as it propagates around the tunnel circuit to the test section by various sound absorbing devices (Approach 1), or,
- o Reduce the noise of the (principal) source by rebuilding or replacing the wind tunnel fan (Approach 2).

The third approach is simply a combination of the two philosophies. Obviously in this case, fewer sound absorbing devices in the tunnel circuit would be needed to achieve the goal.

Since BBN reached the conclusion that rebuilding or replacing the fan would not by itself produce sufficient noise reduction to achieve the goal, only approaches 1 and 3 were considered appropriate for meeting the NASA goal. These approaches are summarized schematically in Figure 2.

Approach 1 contains the following detailed features:

- o anechoic treatment in test section
- o absorption added to collector surfaces
- o long-chord treated turning vanes in the first corner
- o fan inlet treatment consisting of a lined wall, a long treated nose cone, and a streamlined-treated splitter ring
- o fan exhaust treatment consisting of the same elements as the inlet treatment

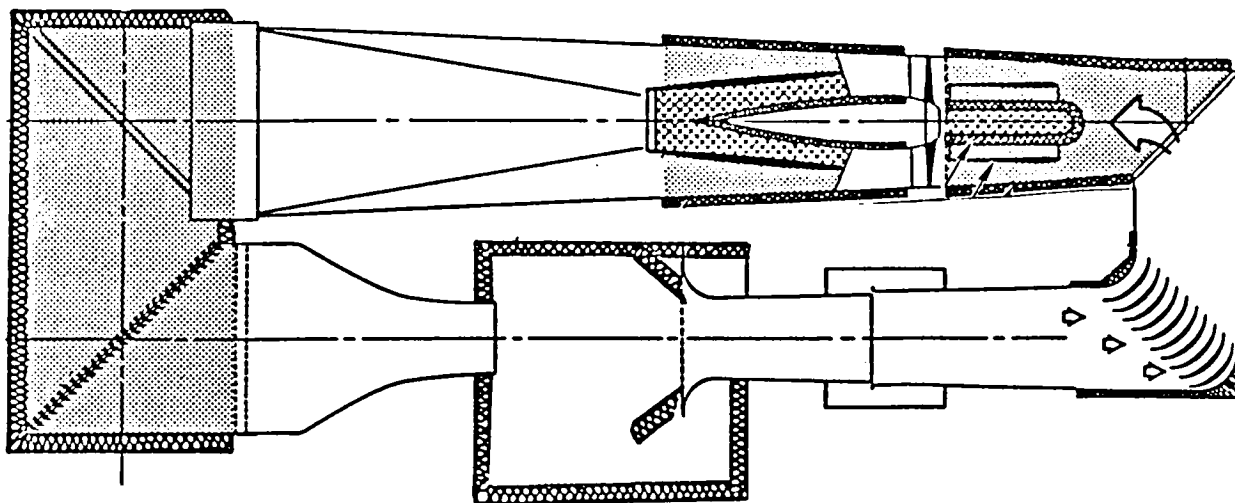
*In an addendum to Reference 4, BBN also present a fourth option. This option is not discussed here since considerable uncertainty exists about its effect on the aerodynamic performance of the wind tunnel.

IMPACT ON FACILITY CAPABILITIES AND OPERATIONS

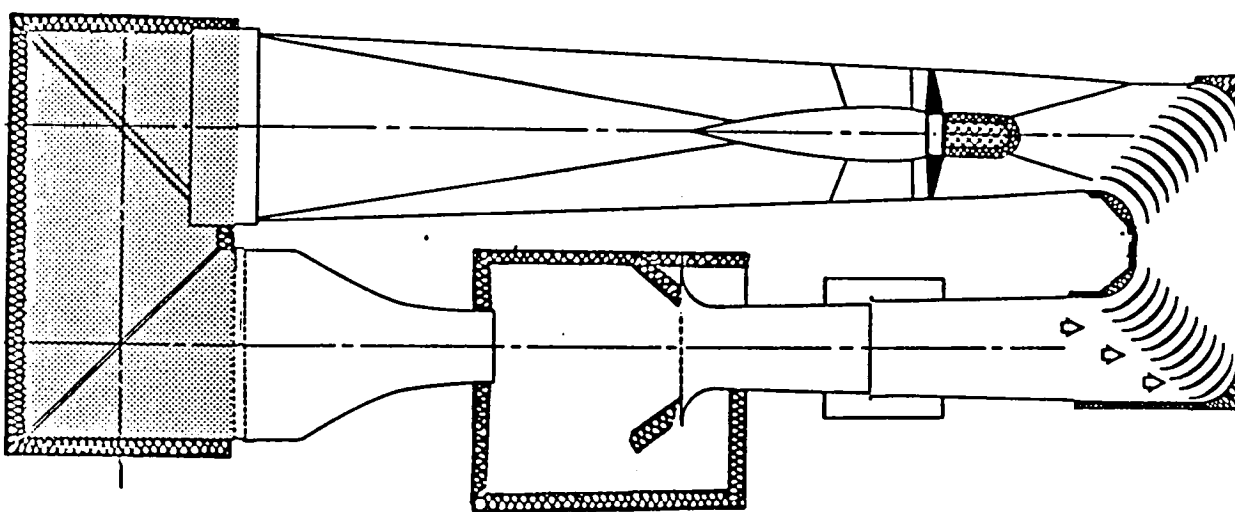
APPROACH*	BACKGROUND NOISE GOAL	FLOW QUALITY PLANNED FLOW QUALITY	MAXIMUM q_0 CURRENT MAXIMUM q_0	RELATIVE INITIAL COST	RELATIVE OPERATIVE COST	MAINTENANCE REQUIRED	DOWNTIME FOR CONVERSION	ADDITIONAL STEPS NEEDED
① Maintain Current Fan; Add Acoustic Treatment to Circuit	Can Meet or Exceed	Possible Minor Degradation (or Minor Improvement)	May Reduce by 8-10%	High	Increase $\propto \Delta q/q_0$	Periodic Cleaning of Certain Treatment	Substantial (to Be Determined)	<ul style="list-style-type: none"> ● Model Tests ● Design ● Procurement
② Rebuild Fan	Probably Can't Meet Without Some Treatment in Circuit	Could Improve	Could Increase	Low	Below Current Costs	Probably Below Current Levels	Substantial (to Be Determined)	<ul style="list-style-type: none"> ● Model Tests ● Full Scale Flow Measurements ● Design ● Model Test ● Procurement
③ Rebuild Fan and Add Acoustic Treatment to Circuit	Could Exceed Goals by Large Margin	Could Improve	Could Increase	High to Highest	Below Current Costs	FAN: Less Than Current TREATMENT: Periodic Cleaning	Substantial	① + ②

* All choices assume that suitable anechoic treatment will be installed in test section.

Table 1 Summary of Approaches to Background Noise Reduction and Impacts of Each (Table 14 of Reference 1)



Option 1 (no fan redesign)



Option 2 (significant fan redesign)

Figure 2 Two "Optimized" Approaches to Acoustic Treatment of the 4 x 7 m Tunnel Circuit (Figure 4 of Addendum to Reference 1)

- o a lined settling chamber ("second crossleg")
- o treated airfoil-shaped fourth corner vanes

Approach 2 illustrates the treatment required for the case where the fan has been redesigned to operate unstalled at approximately 50% of its present tip speed. The fan redesign requires new blading (larger chord, and pitch settings tailored to local inflow), and the addition of a nose cone. The additional absorptive elements required include:

- o anechoic treatment in test section
- o absorption added to the collector surfaces
- o treated first corner vanes
- o treated (elongated airfoil-shaped) second corner vanes
- o lined settling chamber surfaces

2.2 General Comments on Fan Noise Reduction

The first phase of the BBN activity described in Reference 1 was source identification and source-path definition. This was based on the results of a series of exhaustively planned and satisfactorily executed tests. Analysis of the test data identified the fan and fan inflow non-uniformity as a major problem area. The important point being that the fan is not only the principal noise source but that it is also noisier than it needs to be.

This conclusion is readily understandable and may indeed be anticipated from a knowledge of the fan design and from tunnel circuit flow measurements^{8,9}. The fan design is representative of old propellor technology with regard both to noise and propulsive efficiency. The present design (Figure 3) has low solidity and short chord blades. A modern high solidity design with long chord swept blades would possess not only greater aerodynamic efficiency but would also turn at a lower speed and generate less noise.

An associated problem with the 4 x 7 m tunnel fan noise is a non-axially-symmetric fan inflow profile with the flow being skewed towards the outer wall. This problem has been substantially improved by the addition of a set of trailing-edge flaps attached to the five flow-control vanes downstream of the first corner⁹. However, the problem is still present as shown in Figure 4, and certainly accounts for a substantial portion of the present excess fan noise.

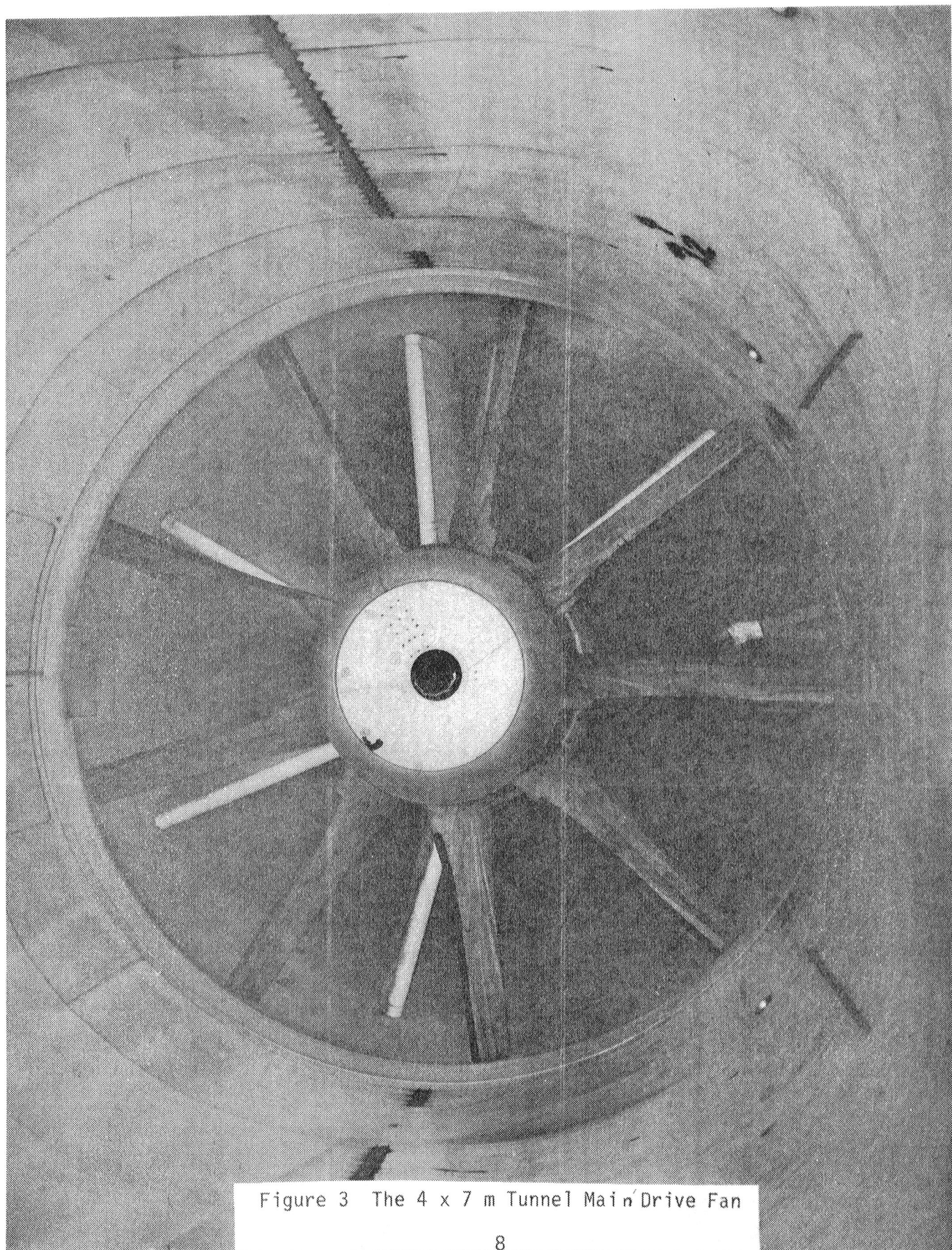


Figure 3 The 4 x 7 m Tunnel Main Drive Fan

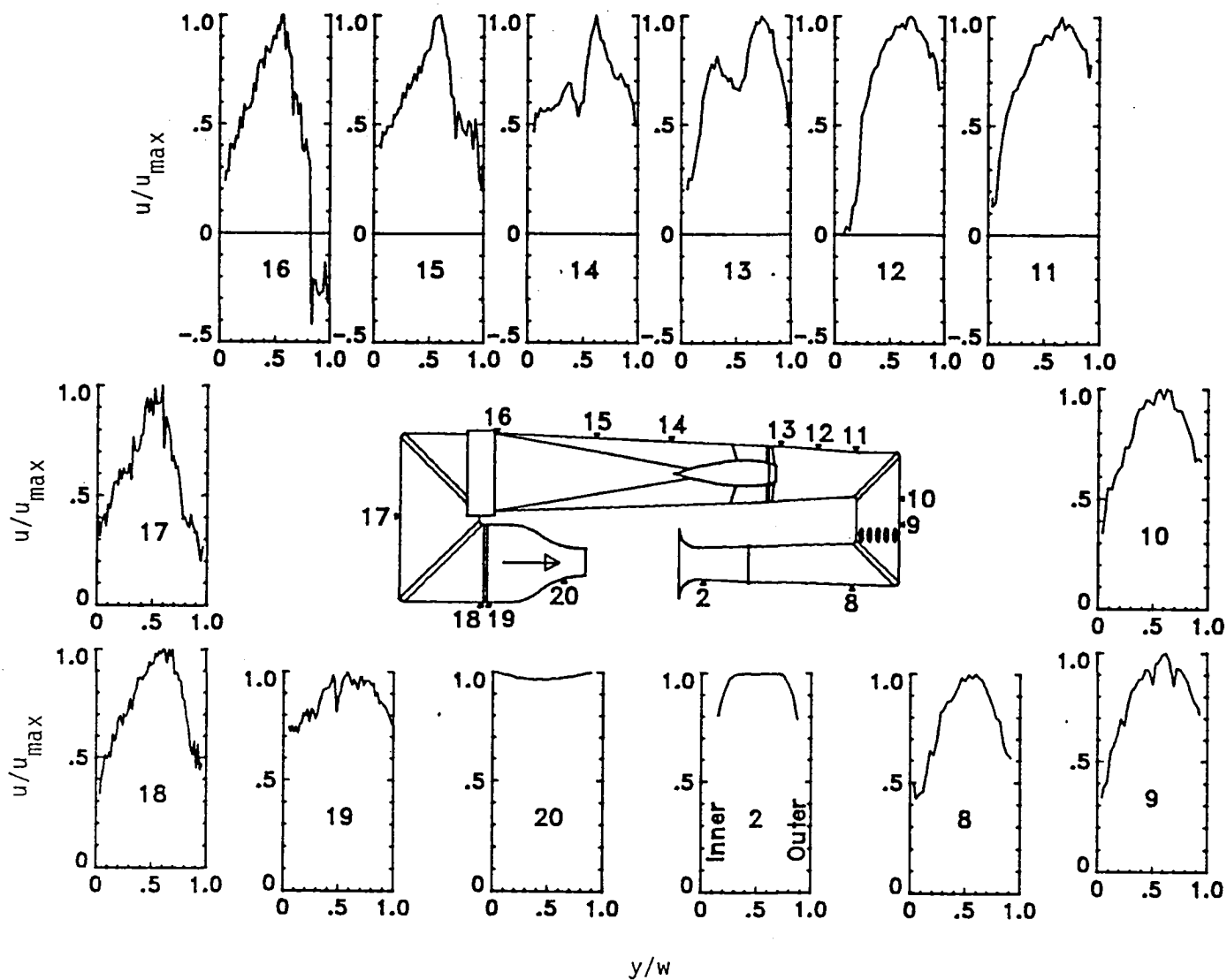


Figure 4 Survey of Flow Profiles Around the
4 x 7 m Tunnel Circuit (From Ref. 9,
Figure 9(b) $q_{TS} = 58$ psf)

BBN present an estimate of potential noise reduction (Figure 5) from fan redesign and inflow improvement of approximately 25dB from 40 to 4,000 Hz, for a 50% tip speed reduction. Their estimate for a 25% tip speed reduction is 15dB.

The opinion of this author is that actual realization of these noise reductions should be attainable, but differing degrees of difficulty and confidence are associated with each step:

- o Fan Tip Speed Reduction - At a test section velocity of Mach .25 the fan inflow velocity is approximately only Mach .06 while the fan tip speed is approximately Mach .55. Thus clearly, it may be observed with a high level of confidence that a reduction of tip speed by a factor of $\frac{1}{2}$ would yield a noise reduction of the order of 15dB (using a V^5 scaling law).
- o Fan Stall Elimination - Fan stall elimination should be possible with fan redesign, in a tunnel where the inflow to the fan is reasonably symmetric about the tunnel centerline. Significant effort has already been spent on flow symmetrization in the 4 x 7 m Wind Tunnel. However, the problem still exists, and will hamper efforts at stall elimination. Unsymmetric flow is a problem common to most recirculatory wind tunnels and its rectification may not be achievable without substantial effort and cost.

The level of confidence of achieving a symmetrical flow and associated noise reduction benefits is much lower than in the former case.

2.3 Comments on Source-Path Treatment Options

Although Reference 1 performs a satisfactory job of defining acoustic sources and paths in the 4 x 7 m Tunnel, and adequately defines the noise attenuation goals for each source, significant gaps exist in the predicted performance of recommended acoustic treatments. Part of the reason for this deficiency is that the effect of the recommended acoustic treatments is difficult to estimate reliably by traditional rule-of-thumb acoustical engineering methods. Another reason is that a detailed study of each component treatment was probably beyond the scope of Reference 1 activity.

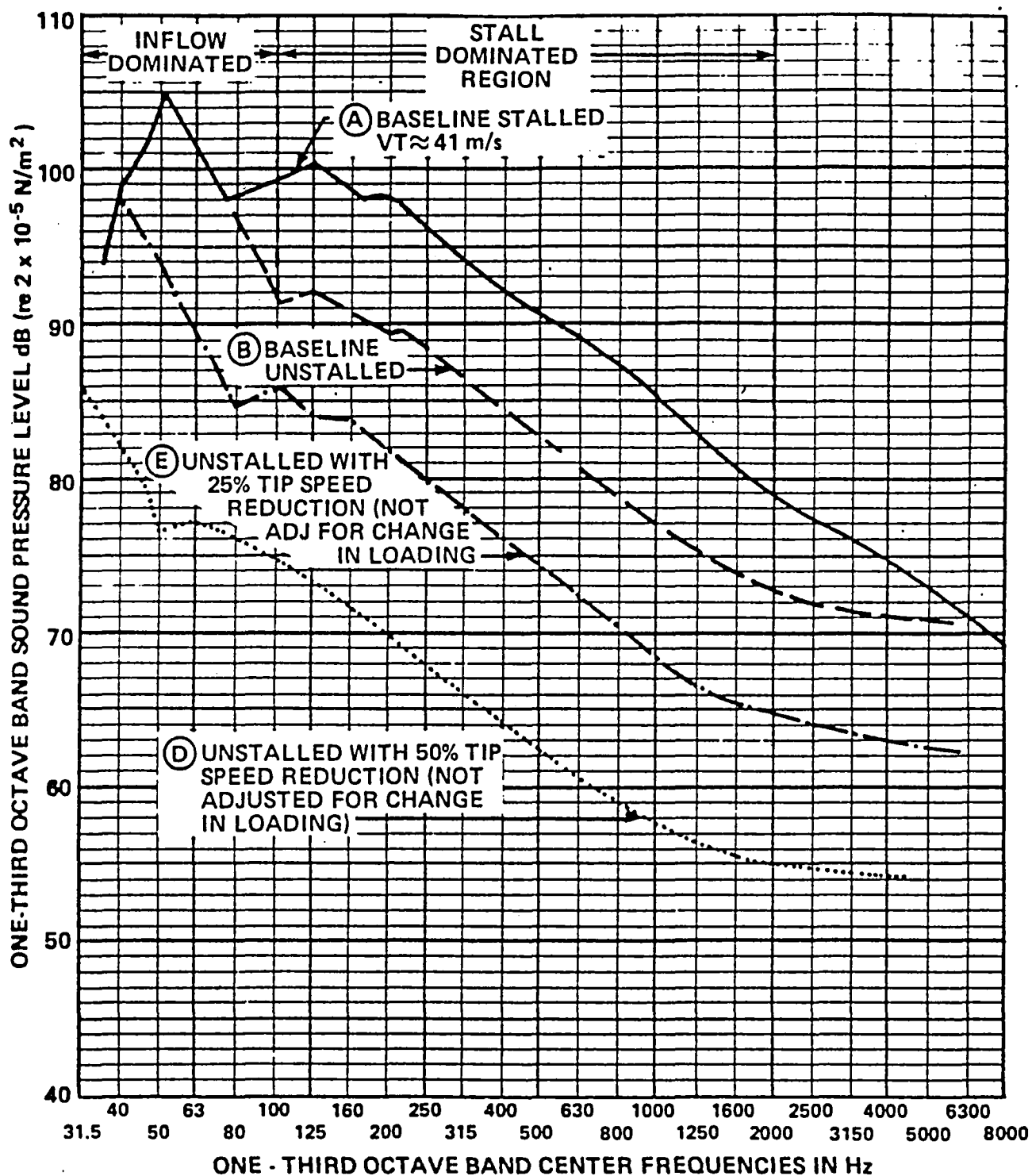


Figure 5 BBN Estimate of Potential Noise Reduction From Fan Redesign and Inflow Improvement (From Ref. 1, Figure 44)

Unfortunately, the result of this situation is that a high level of uncertainty exists about the performance of source path treatment concepts schematically presented in Figure 2, and detailed calculations for various local design options are still required for the following components:

- o Acoustically treated turning vanes
- o Large area duct wall treatment
- o Fan nose-cone, splitters and duct treatment

However, one notable omission appears to have been made by BBN. This omission calls into question the validity of the basic conclusions of their study (summarized here in Table 1 and Figure 1). This omission arises from a misunderstanding of the way in which sound propagating around the circuit of a wind tunnel, radiates into an anechoically treated test section.

From measurements taken in the present untreated test section of the 4 x 7 m tunnel, BBN found that the difference between centerline and sideline background noise levels was approximately 5dB. A further 5dB was allowed for the estimated decrease in sideline background noise due to anechoic treatment of the test section.

The analysis described in the following section shows a difference between centerline and sideline background noise levels of the order of 25 to 30dB. These calculations are supported by measurements in the DNW acoustic wind tunnel, which are also described in the following section.

If sideline measurements are the only acoustic measurements required in the 4 x 7 m tunnel, then this unexpectedly large benefit from an anechoically treated test section, reduces the need for additional acoustically absorbant circuit treatment.

3 RADIATION INTO AN OPEN TEST SECTION

3.1 Measurements in the DNW Tunnel

Some words of introduction are helpful in understanding the relevance of acoustic measurements in the DNW Tunnel with respect to the NASA Langley 4 x 7 meter tunnel.

The concept of a wind tunnel specially designed for acoustic measurements is relatively new. Over the past fifteen years, numerous acoustic measurements have been made in existing wind tunnels which have been partially (and usually inadequately) adapted for that purpose. The first large scale facility, however, which reflects a genuine attempt to design for aero-acoustic capability is the Duits - Nederlandse Wind tunnel (DNW) recently completed at Noordoostpolder in Holland. The acoustic capabilities of this tunnel are described in Reference 10, and are also contrasted with the 4 x 7 m tunnel in Reference 1.

The existence of the DNW tunnel, coming particularly at a time when the need for such a facility in the United States is becoming increasingly apparent, is acting as a stimulus for action in the development of an equivalent facility.

In comparing the physical layout (Figures 6 and 7) and operational characteristics (Table 2) of the NASA Langley 4 x 7 meter tunnel with the DNW tunnel, it may be seen that the two facilities are broadly similar.

In general, the DNW tunnel is larger with a slightly greater maximum test section velocity in the open jet mode. However, planned improvements to the collector of the LaRC 4 x 7 m tunnel are expected to increase maximum velocity to a level comparable with DNW. Also, planned flow quality improvements (see Figure 6) are expected to decrease the turbulence level in the 4 x 7 m tunnel.

In presenting their comparison of 4 x 7 m tunnel and DNW tunnel noise data in Reference 1, BBN omitted DNW in-flow noise measurements. The reason given for this omission was that these measurements were clearly in error due to their relatively high level when compared with out-of-flow data, probably due to their contamination with microphone or microphone support self-noise.

4-BY 7-METER TUNNEL MODIFICATIONS

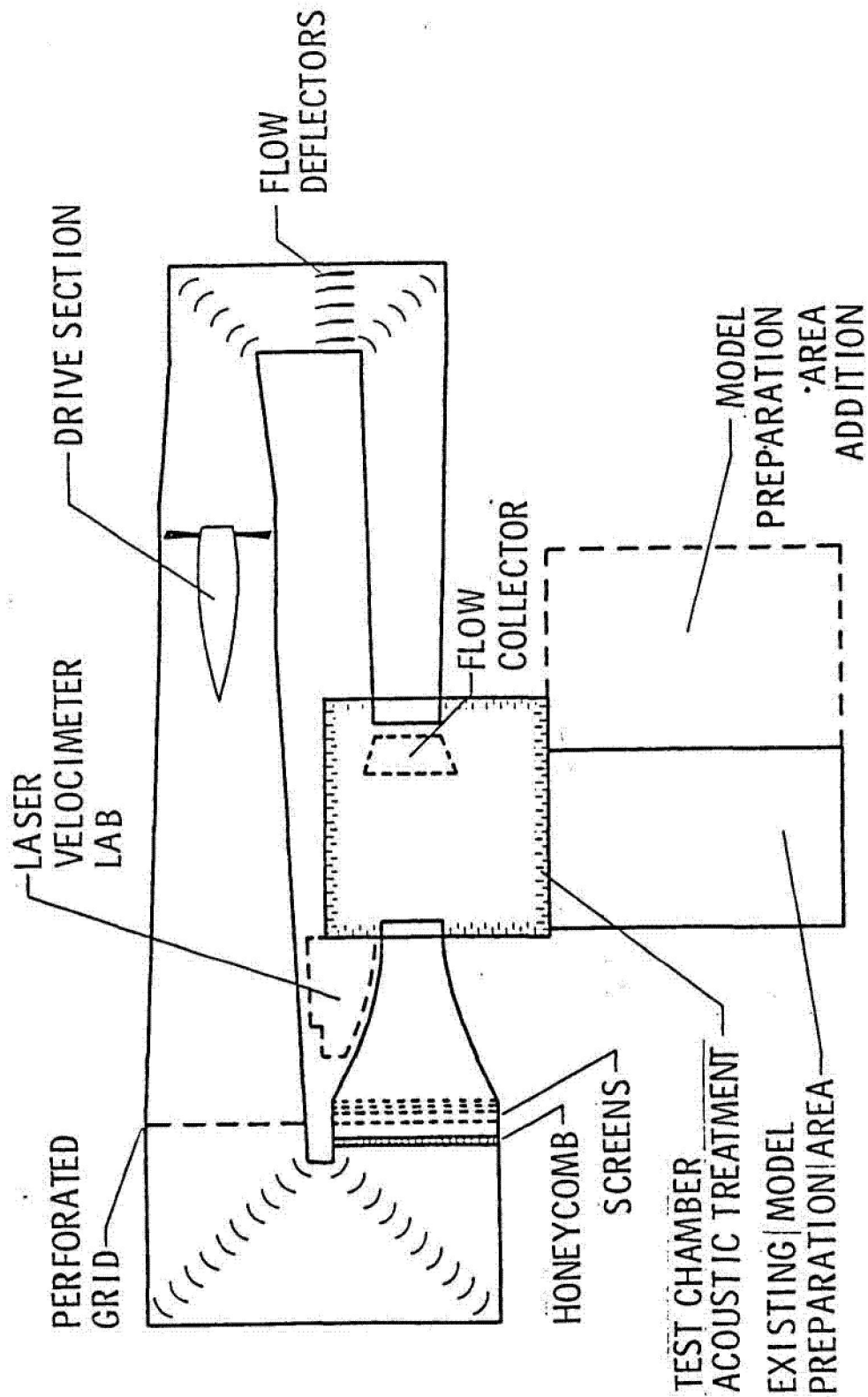


Figure 6 Layout of NASA LaRc 4 x 7 Meter Tunnel Including Planned Flow Quality Improvements

TABLE 2

Comparison of the Operational Characteristics of the NASA LaRC 4 x 7 Meter Tunnel with the DNW Tunnel		
<u>Characteristic</u>	<u>LaRC 4 x 7m</u>	<u>DNW</u>
Dimensions of Test Section	4 x 7m	6 x 8m
Overall Circuit Dimensions	97 x 20m	128m x 31m
Maximum Velocity (Open Test)	62m/sec.*	85m/sec.
Maximum Fan Tip Mach Number	M.5	M.5
Maximum Distance from Model Center- line to Test Section Wall	14m	15.5m
Turbulence Level (long., lat.)	.3%, 1.3%	.2%, .1%
Fan Tip Diameter	12.5m	12.3m
RPM (at 85 m/s Test Vel.)	275	225
Tip Speed (at 85 m/s Test Vel)	180 m/sec	145 m/sec

* Will be increased with installation of new collector

Interestingly, however, when these DNW in-flow measurements are compared with a 4 x 7 m tunnel in-flow data (Figure 8), it may be seen that they are comparable. According to fan tip speed comparisons alone (Table 2) one would expect DNW to be 5dB quieter than the 4 x 7 m tunnel. However, the flow velocity into 4 x 7 m fan is only 60% of the flow velocity into the DNW fan and although the fans are the same size, the DNW fan moves almost twice the volume of air.

Taking these differences into account, it would not be too surprising to find that both fans generate about the same noise level. Following this line of reasoning one would expect that the in-flow noise levels in the two test sections would be similar provided that the transmission paths were also similar. From Figures 6 and 7, it may be seen that this is indeed the case with one major difference. In the DNW tunnel the first and third sets of turning vanes are acoustically treated.

Thus, if we make the assumption that BBN did not, namely, that the DNW in-flow noise measurements are correct, then this leads to the conclusion that the treated turning vanes in the DNW tunnel are only marginally effective in attenuating noise propagating around the tunnel circuit.

Proceeding further on this assumption, it is still necessary to explain the 25 to 30dB difference between in-flow and side-line noise measurements in the DNW tunnel test section (as shown in Figure 8). This task was approached theoretically and is described in the following section.

3.2 Theoretical Calculations of Noise Radiation into an Open Test Section

Calculation of near field acoustic radiation into a semi-reverberant space in the presence of flow is best performed numerically. The tool used for this task was the ADAM System⁽¹¹⁾. This is a general purpose 2-D or axis-symmetric finite element aeroacoustic modeling system.

Calculations were based on the geometry of the 4 x 7 m tunnel, with a new acoustically treated collector, and control room removed. Figure 9 shows sound radiating into this geometry from a plane wave acoustic velocity source located six meters down the first diffuser leg from the collector/diffuser junction. Figure 9(a) shows the pressure distribution over the 2-D space from a source at 30Hz. Figures 9(b) through 9(d) show the same form of result for sources at 60, 100 and 160Hz respectively.

BACKGROUND NOISE LEVELS

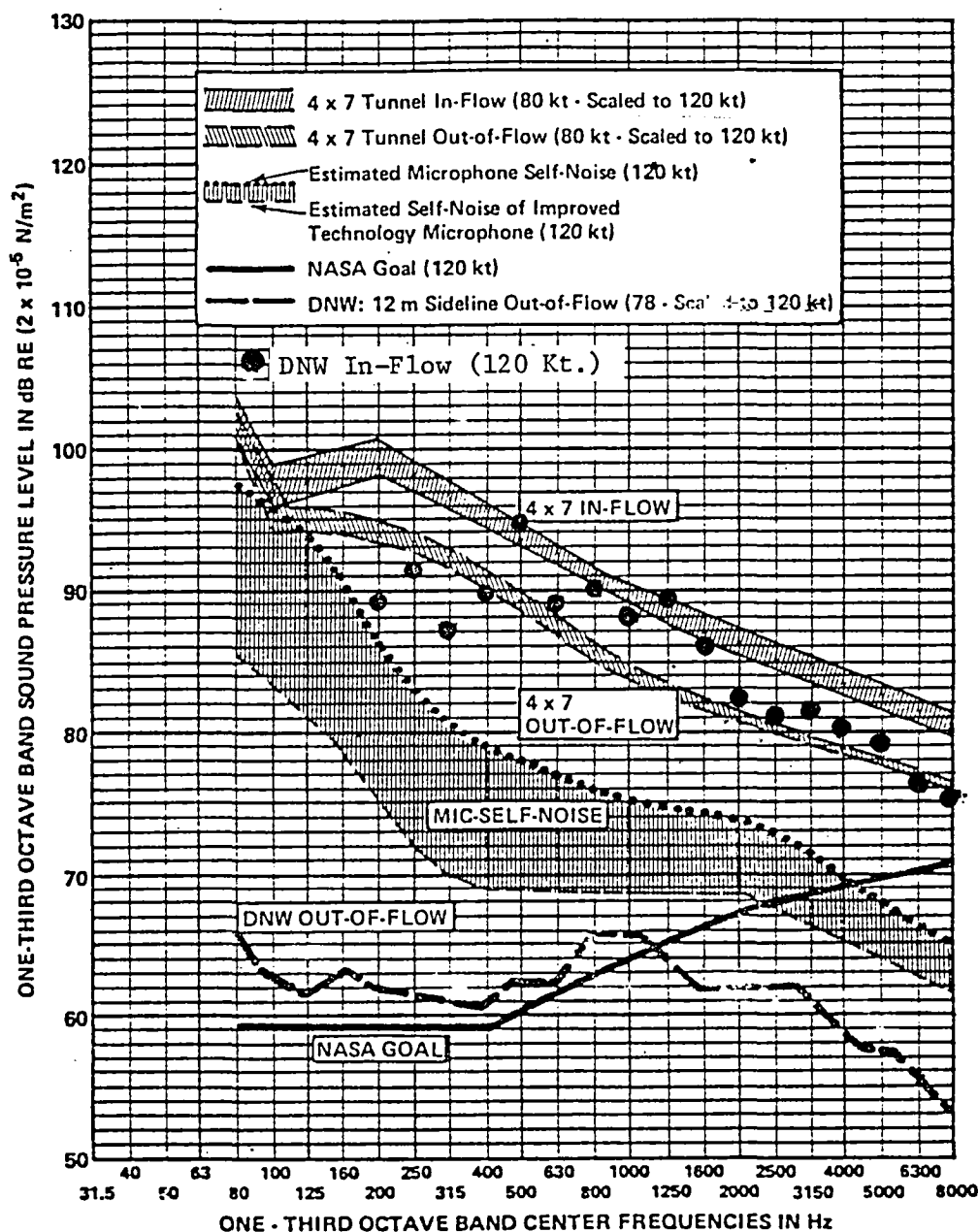


FIGURE 8. COMPARISON OF EXISTING BACKGROUND NOISE LEVELS WITH NASA GOALS, DNW LEVELS, AND IN-FLOW MICROPHONE SELF-NOISE. (Modified Figure 2 from Reference 1)

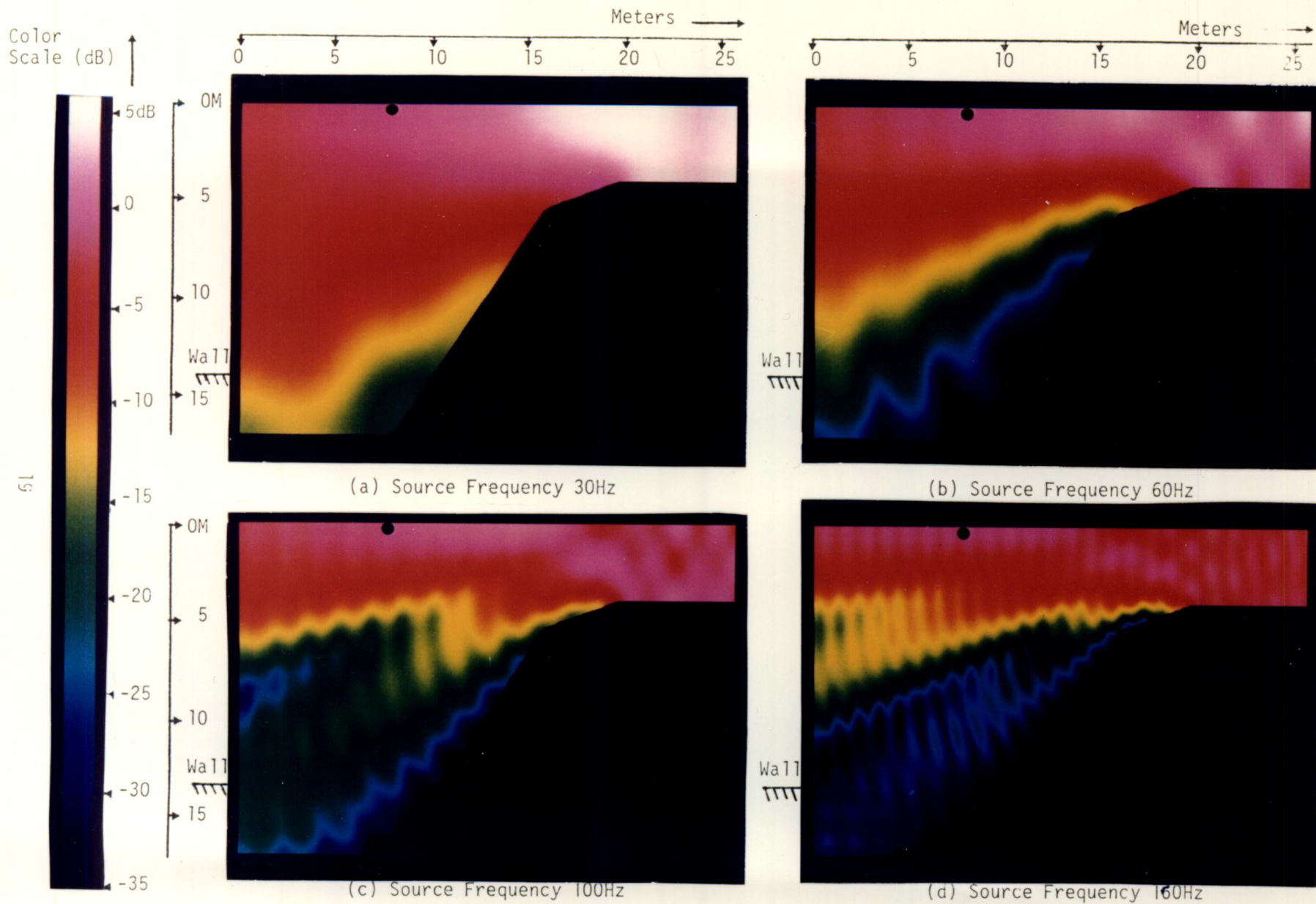


Figure 9. Theoretical Acoustic Radiation Pattern at Four Different Source Frequencies of Noise Propagating around 4 x 7 m Tunnel Circuit into an Anechoically Treated Test Section

● Reference Point (0dB)

The color scale is the same for all four figures and is based on a sound pressure level of 0dB at a reference point on the duct centerline half way between the front edge of the collector and the nozzle. (This reference point is approximately coincident with the position of a test rotor hub). In all cases, a hard wall acoustic boundary condition exists on the diffuser wall with a " ρc " impedance on the collector and all other radiation boundaries. (A " ρc " impedance is a low reflection boundary condition approximating to a radiation condition for a plane acoustic wave). Differences in sound pressure level between the centerline and a sideline coincident with the open test section wall, taken from Figure 9, are listed in Table 3. It may be seen that this difference increases with frequency from (-10 to -15dB) at 30Hz to (-25 to -35dB) at 160Hz.

It is interesting to observe the structure of the radiation patterns in Figure 9 and how they change with frequency. At both 30 and 60Hz only the primary radiation lobe is evident. At 100Hz a secondary lobe makes its appearance while the width of the primary lobe shrinks. At 160Hz, secondary and tertiary lobes are seen with the primary lobe narrowed still further. This is representative of classical radiation behavior.

In Figure 10, two effects are shown:

- (1) The result of replacing the anechoically treated test section and collector by hard walls (Figures 10(a) and 10(b)). This situation approximates to the present environment and is included to show a baseline condition at source frequencies of 80 and 100Hz.
- (2) The effects on the radiation lobe structure at 100Hz, of placing an acoustic lining on an 11 meter long section of the diffuser adjacent to the collector (Figures 10(c) and 10(d)).

It may be seen from Figures 10(a) and 10(b) that a standing wave pattern exists when collector and test section walls are set to a hard-wall acoustic boundary condition. Two frequencies spaced approximately one-third octave apart (80 and 100Hz) are shown to illustrate how the maxima and minima of the standing wave pattern move with frequency. Since an actual one-third octave band level would represent an integration over such a frequency band,

TABLE 3

Theoretical Differences Between Centerline Reference Point and Wall
Sound Pressure Level in the 4 x 7 m Tunnel Open Test Section.

Figure Number	Frequency (Hz)	Flow	Impedance Boundary Condition				SPL Difference from Centerline Ref. to Wall (dB)
			Diffuser	Collector	Radiation Boundary	Nozzle	
9(a)	30	No	Hard	ρC	ρC	ρC	-10 to -15
9(b)	60	No	Hard	ρC	ρC	ρC	-17 to -30
9(c)	100	No	Hard	ρC	ρC	ρC	-19 to -35
9(d)	160	No	Hard	ρC	ρC	ρC	-25 to -35
10(a)	80	No	Hard	Hard	Hard	ρC	Combined Avg. = -5 (Approx.)
10(b)	100	No	Hard	Hard	Hard	ρC	
10(c)	100	No	Hard	ρC	ρC	ρC	-19 to -35
10(d)	100	No	ρC	ρC	ρC	ρC	-20 to -35
11	100	Yes*	Hard	ρC	ρC	ρC	-25 to -35

*Flow = Mach 0.2 with a simple constant measured profile from Reference 9 (Figure 4, this report Station 2).

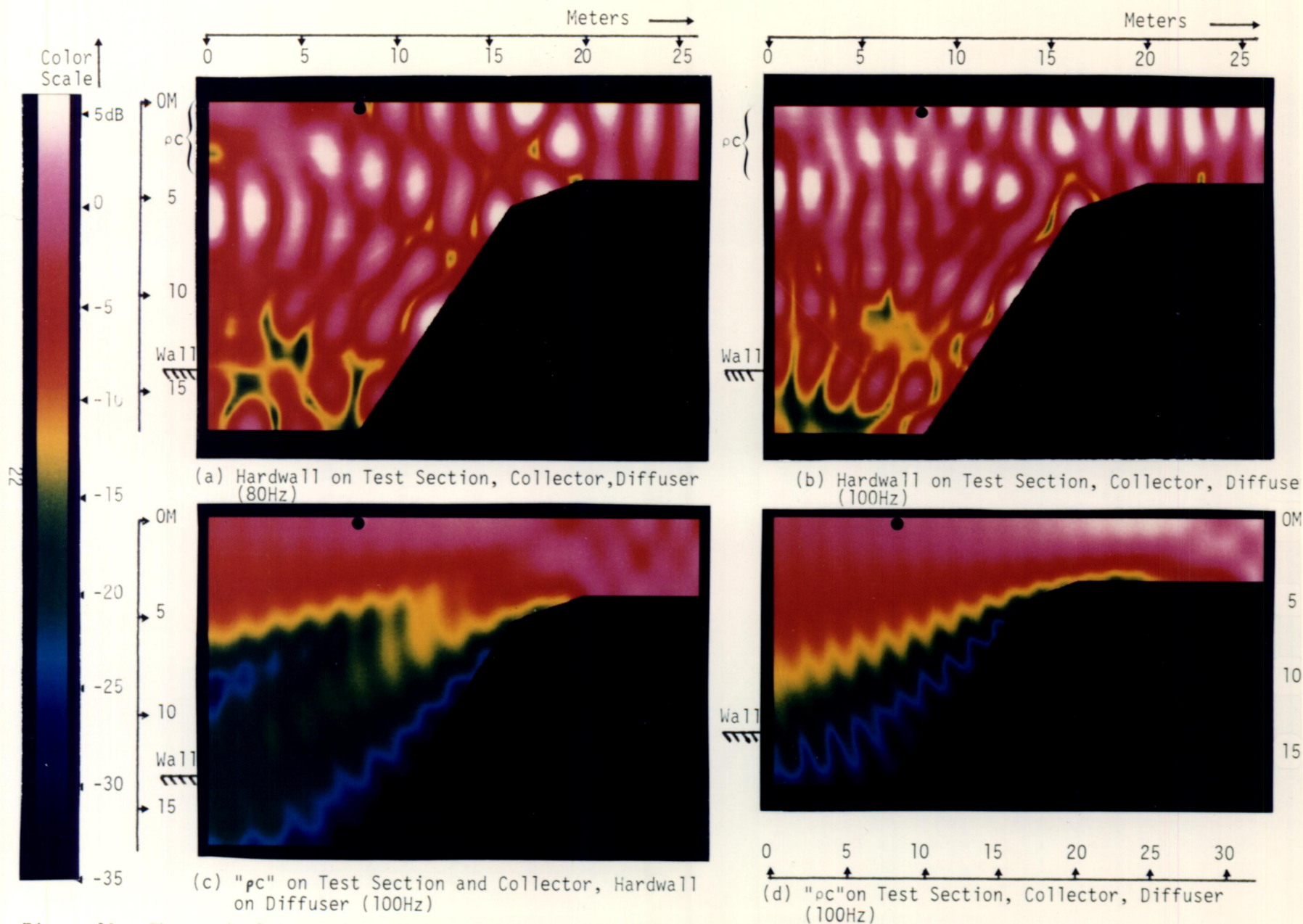


Figure 10. Theoretical Acoustic Radiation Patterns about 100Hz Showing the Effect of Various Wall Boundary Conditions for Noise Propagating into the Test Section of the 4 x 7 M Tunnel.

● Reference Point (0dB)

these two results are averaged to give the sound pressure level difference from the centerline reference point to the wall. This combined average difference is approximately -5dB (Table 3).

On observing the presence of higher order lobes at higher frequencies, the question arose whether these could be "damped-out" by lining the diffuser wall with acoustically absorbant material. Figure 10(d) shows a lengthened diffuser section with 11 meters of " ρc " wall impedance at a source frequency of 100Hz. By comparing this case with the hardwall diffuser case (Figure 9(c), also reproduced as Figure 10(c) for convenient comparison) it may be seen that the second order lobe is indeed removed. However, the primary lobe has also been broadened, so that the net effect on centerline to wall SPL difference is negligible.

Figure 11 shows the same case as presented in Figures 9(c) and 10(c) of sound propagation along a hardwall diffuser at 100Hz into an anechoic test section with treated collector. The difference is that flow at a free-stream velocity of Mach 0.2 has been added. A constant velocity profile taken from measured data⁹ (Figure 4, Station 2 this report) was used. Although this constant flow profile is somewhat unrealistic, it nevertheless serves to show some interesting results.

For sound propagating upstream (the principal path for fan noise identified in Reference 1), the effect of flow is to remove the higher order radiation lobe and to refract sound towards the duct centerline, substantially narrowing even the primary radiation lobe. The effect of flow on upstream sound propagation is thus to increase the difference between sound pressure levels on the duct centerline and test section wall to a -25 to -35dB range.

Various checks on other acoustic variables (e.g. Phase, Acoustic Flux) were performed to verify the integrity of the analysis. Examples of these parameters are shown in the Appendix.

Because of rapidly escalating computational cost for numerical solutions of aeroacoustic partial differential equations at higher frequencies in large spaces, the upper frequency used for this analysis was 160Hz. At higher frequencies the established trends are expected to continue for an anechoically treated test section. That is, the differences between centerline and side-line sound pressure level will tend to increase with increasing frequency.

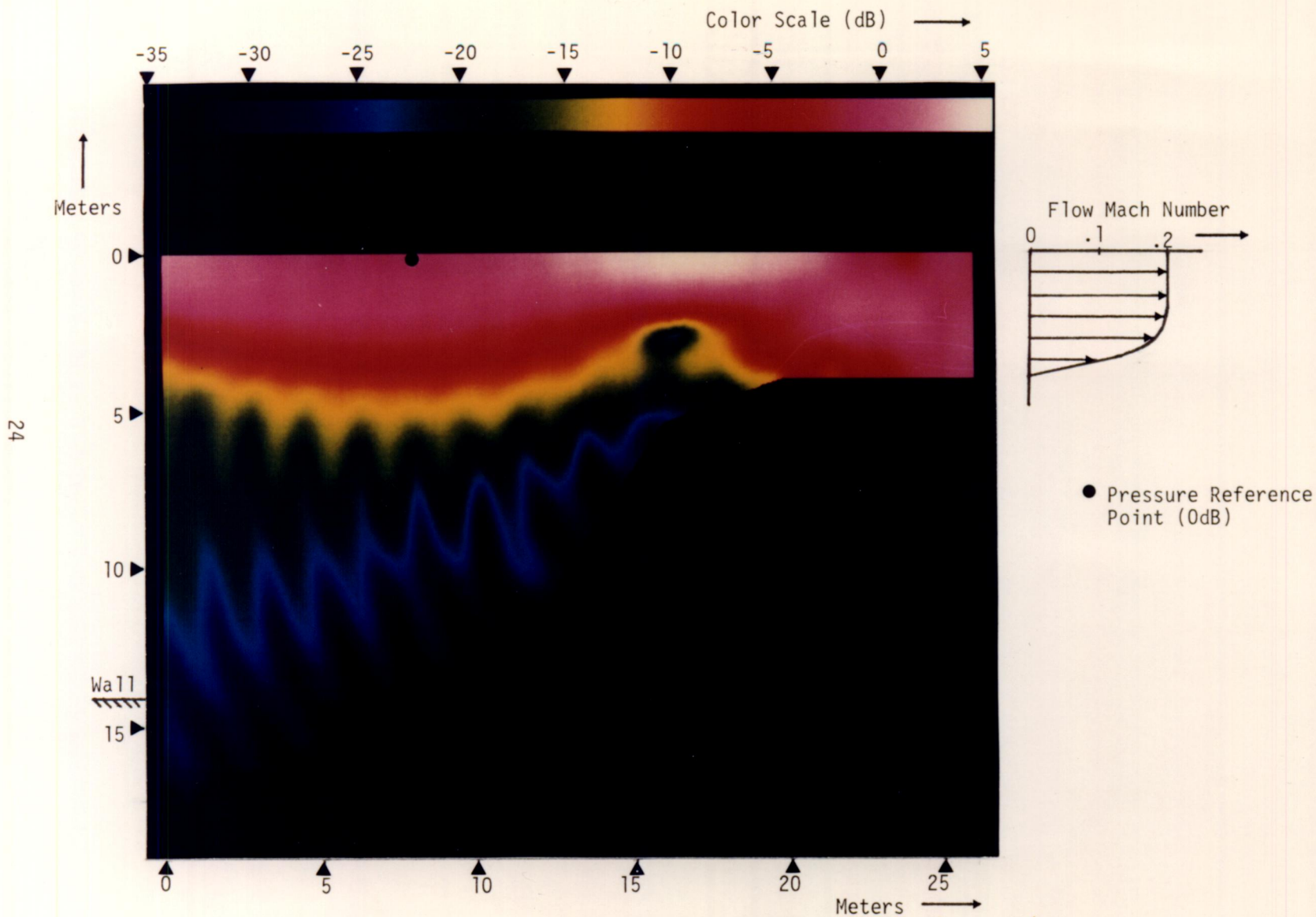


Figure 11. Theoretical Acoustic Radiation Pattern at 100Hz of Noise Propagating around 4 x 7 M Tunnel Circuit into an Anechoic Test Section with a Mach 0.2 Mean Flow

4 CONCLUSION

The BBN report¹ on "Sources, Paths and Concepts for Reduction of Noise in the Test Section of the NASA Langley 4 x 7 m Wind Tunnel" has correctly identified the 4 x 7 m tunnel fan and non-axisymmetric inflow to the fan as a major problem area. The basic conclusion is that the fan is at least 15dB noisier than it needs to be, and that a reduction of up to 25dB might be attainable from fan redesign and symmetrization of the inflow.

However, one notable omission appears to have been made by BBN. This omission arises from a misunderstanding of the way in which sound propagating around the wind tunnel circuit, radiates into an anechoically test section. The present study has shown both by calculation and by reference to measurements in the DNW tunnel in Holland, that large differences (25 - 30dB) may exist between sound pressure levels measured on a test section centerline, and those measured close to the wall in a large anechoic open test section.

Thus, if only sideline measurements are required in a NASA acoustic wind tunnel, then the conclusions of Reference 1, regarding the need for tunnel circuit treatment in the LaRC 4 x 7 m tunnel are invalidated.

Further, interesting points have been raised by the analyses and comparisons presented in this report. Uncertainty still exists in regard to the performance of the DNW Acoustic Wind Tunnel, however, if the in-flow noise measurements presented in Reference 10 are correct, then this implies that the performance of the acoustically treated turning vanes installed in this tunnel may be poor. Further study of acoustically treated turning vanes is recommended.

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APPENDIX

Additional Parameters Calculated by the "ADAM" Analyses.

As verification of the "ADAM" analyses and to provide further insight into the radiation of noise propagating around the wind tunnel circuit into the test section of the 4 x 7 m Tunnel, additional parameters are plotted in this appendix.

The only parameter needing explanation is acoustic flux. This parameter represents an integration of acoustic intensity over a line normal to the tunnel centerline.

In most instances, relatively little acoustic energy is absorbed by the side walls and acoustic flux is almost constant across successive sections normal to the test section centerline.

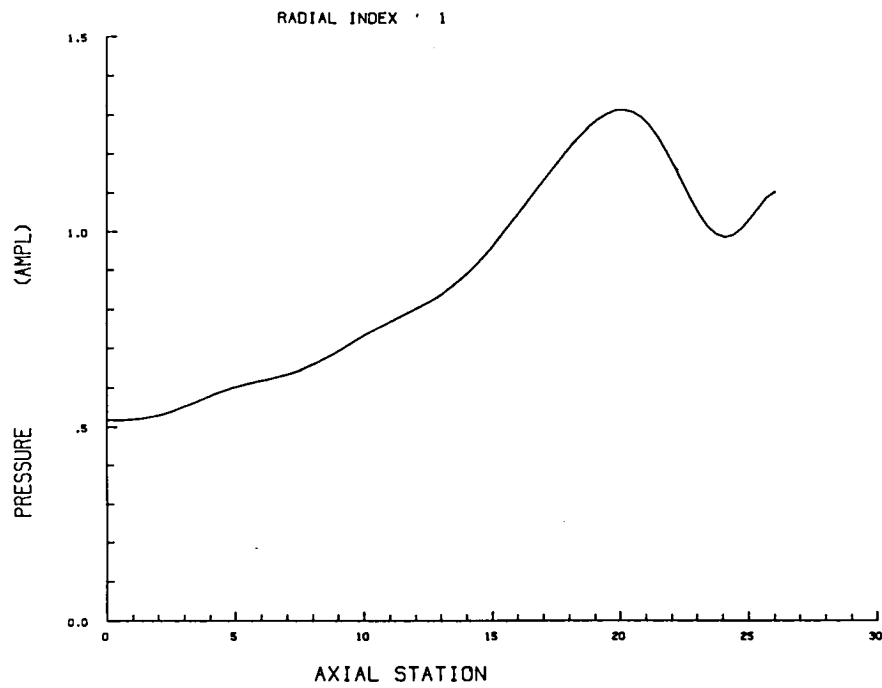


Figure A1. Plot of Pressure Amplitude at 30Hz
Down Tunnel Centerline for Figure 9(a)

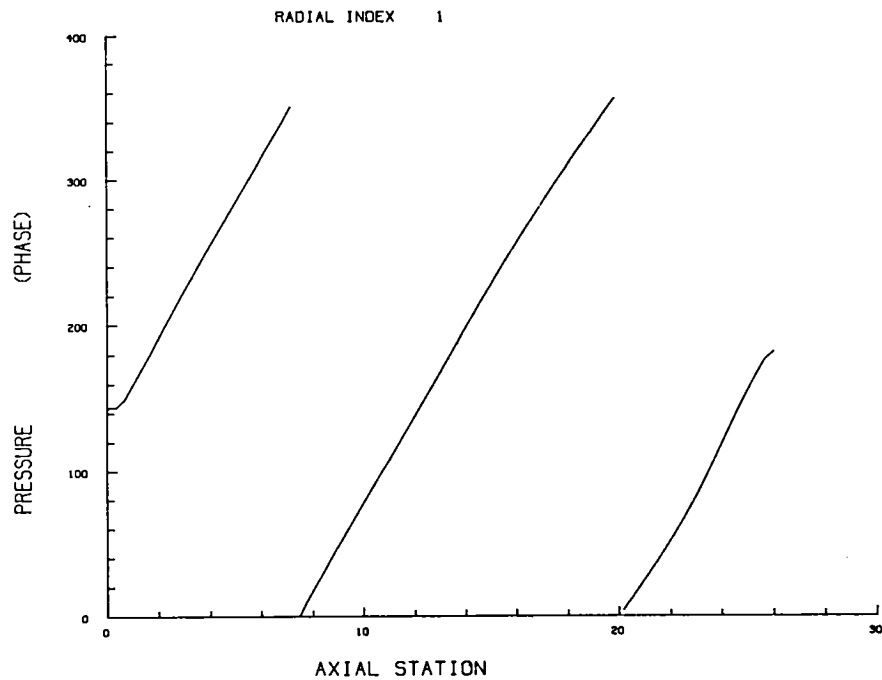


Figure A2. Plot of Pressure Phase at 30Hz
Down Tunnel Centerline for Figure 9(a)

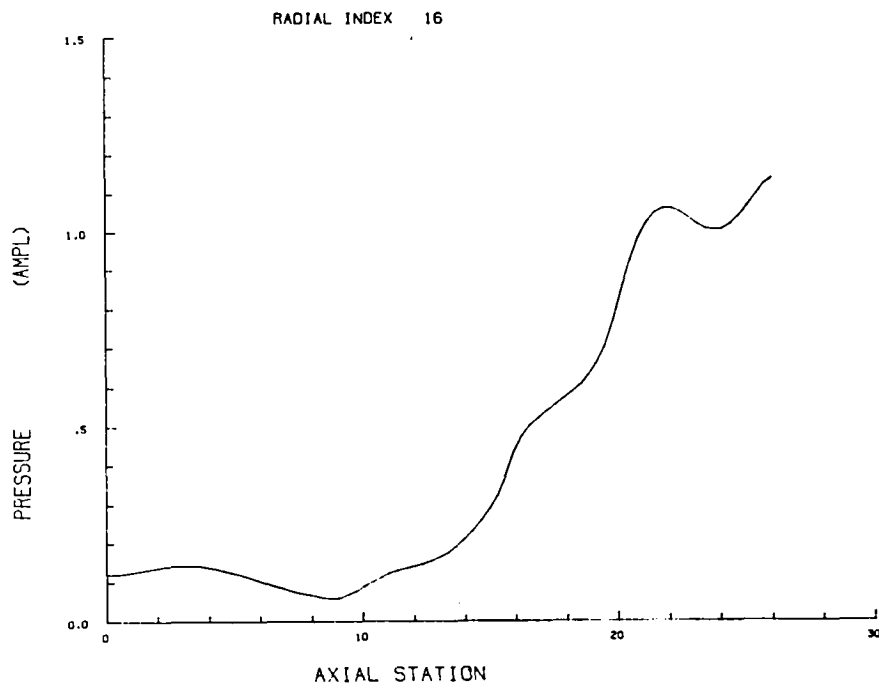


Figure A3. Plot of Pressure Amplitude at 30Hz
Along Radiation Boundary - Collector -
Diffuser, for Figure 9(a)

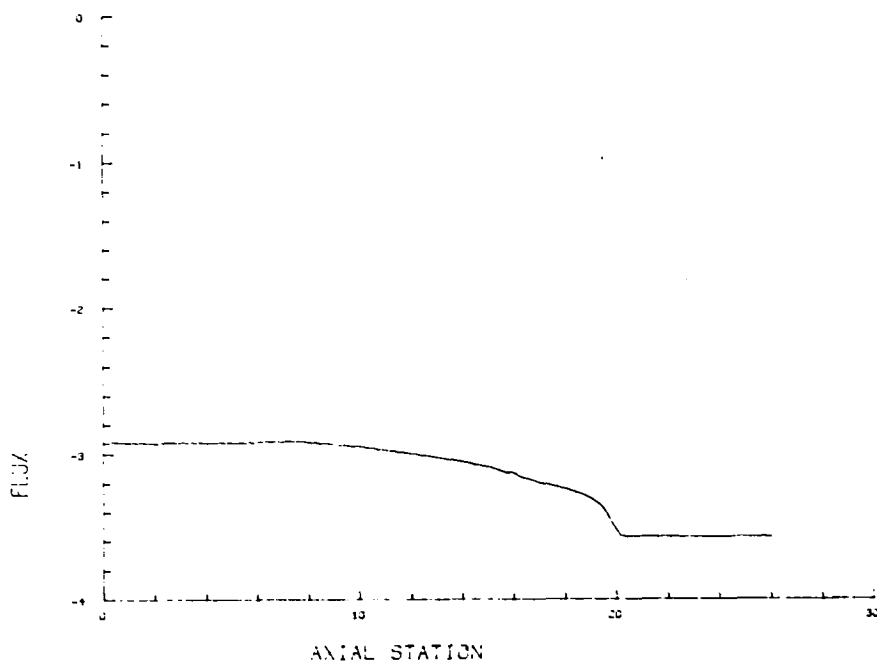


Figure A4. Plot of Acoustic Flux Across Sections
Normal to Centerline at 100Hz for Figure 9(c)

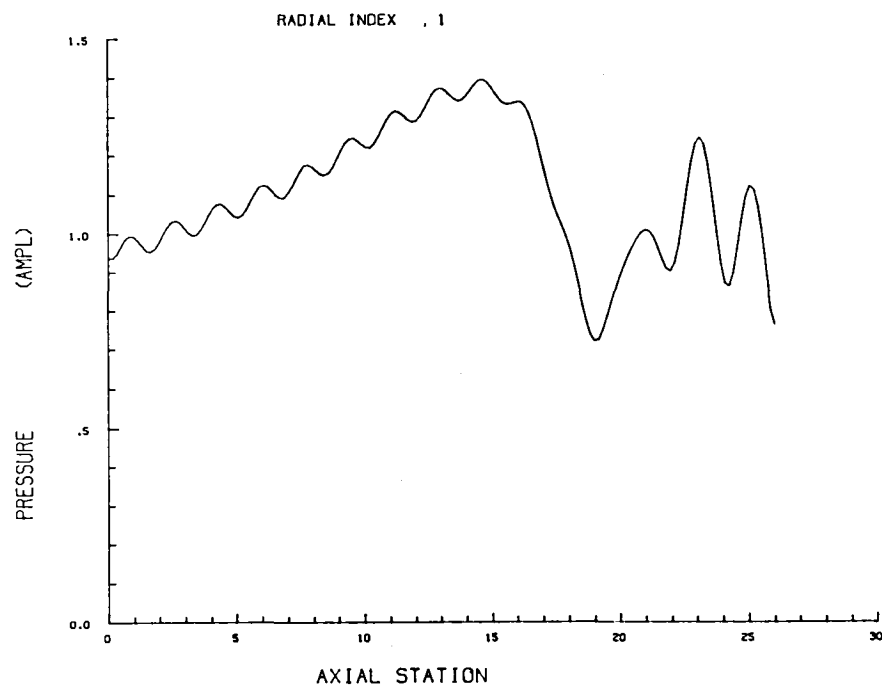


Figure A5. Plot of Pressure Amplitude at 100Hz
Down Tunnel Centerline for Figure 9(c)

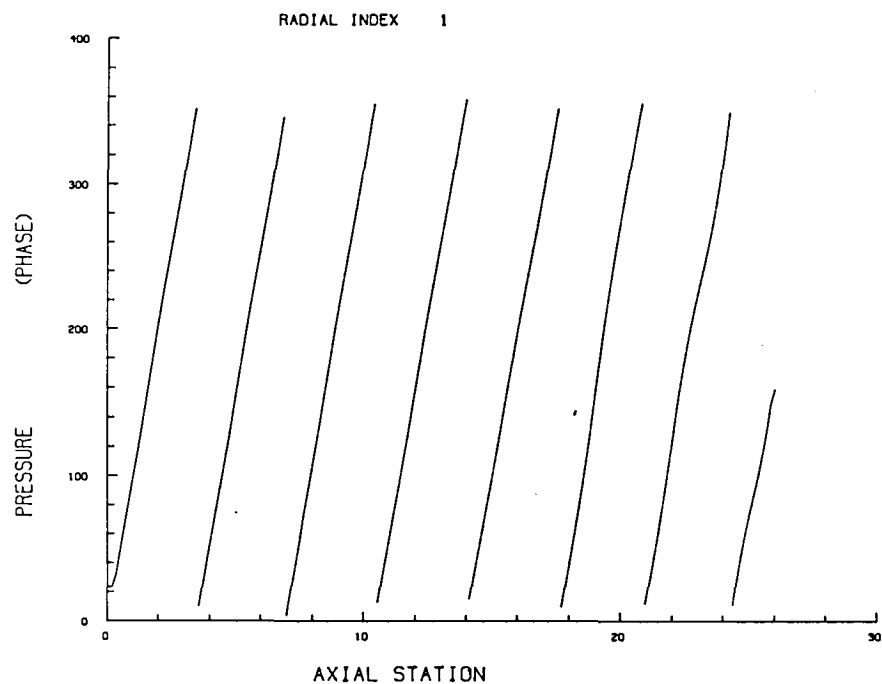


Figure A6. Plot of Pressure Phase at 100Hz
Down Tunnel Centerline for Figure 9(c)

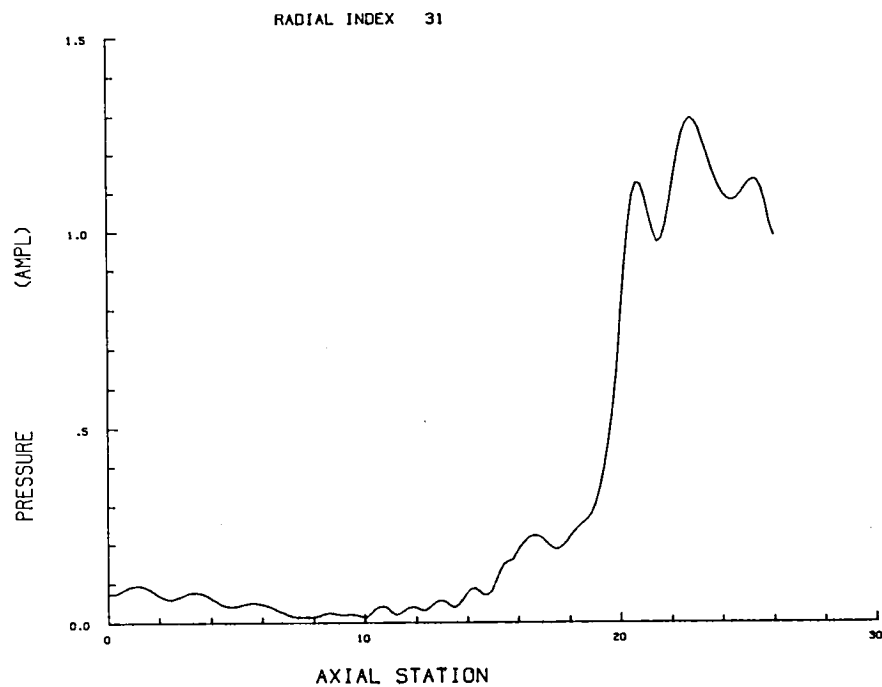


Figure A7. Plot of Pressure Amplitude at 100Hz
Along Radiation Boundary - Collector -
Diffuser for Figure 9(c)

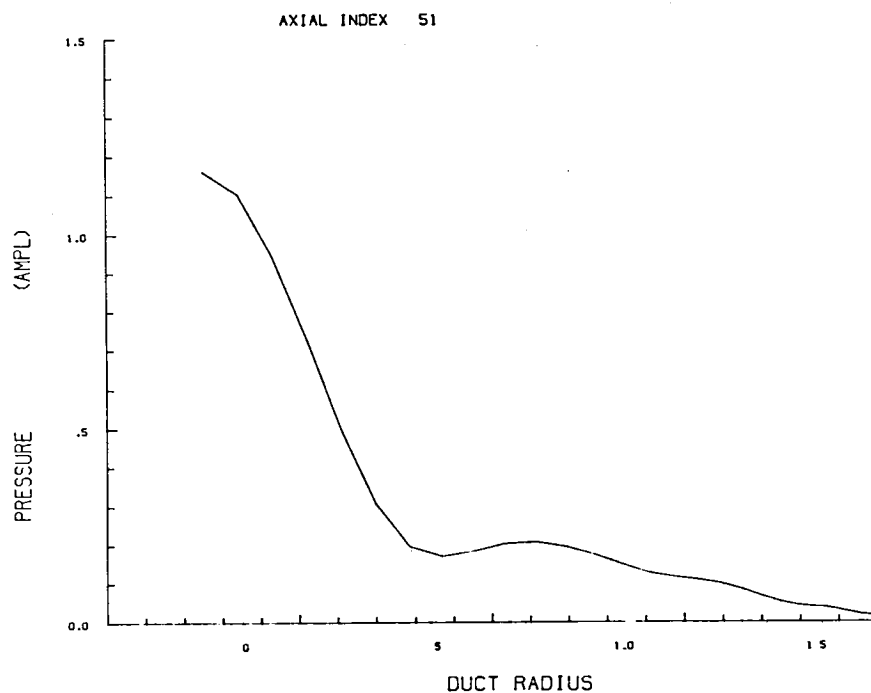


Figure A8. Plot of Pressure Amplitude at 100Hz
Normal to Radiation Boundary Through
Centerline Reference Point for Figure 9(c)

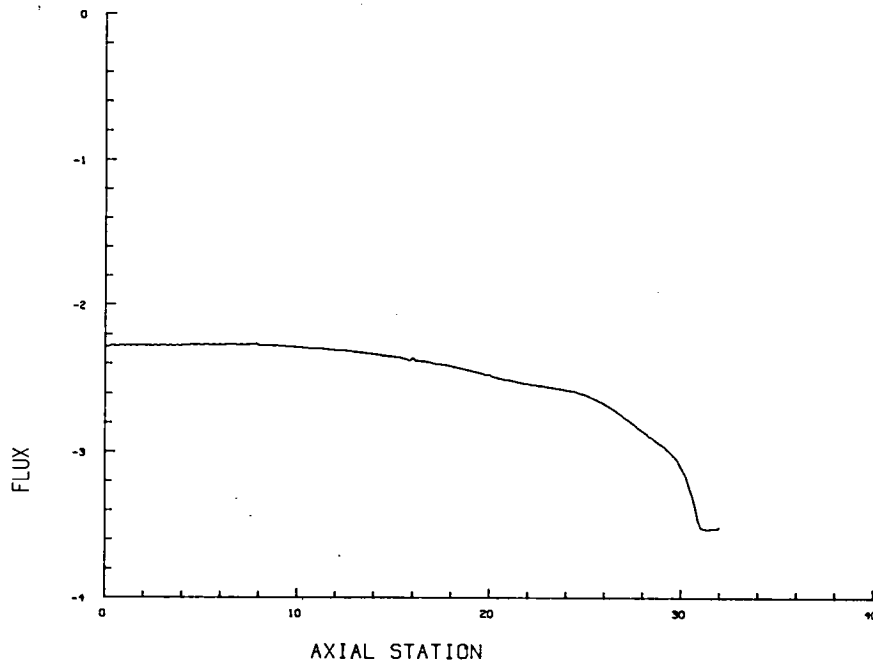


Figure A9. Plot of Acoustic Flux Across Sections
Normal to Centerline at 100Hz for Figure 10(d)

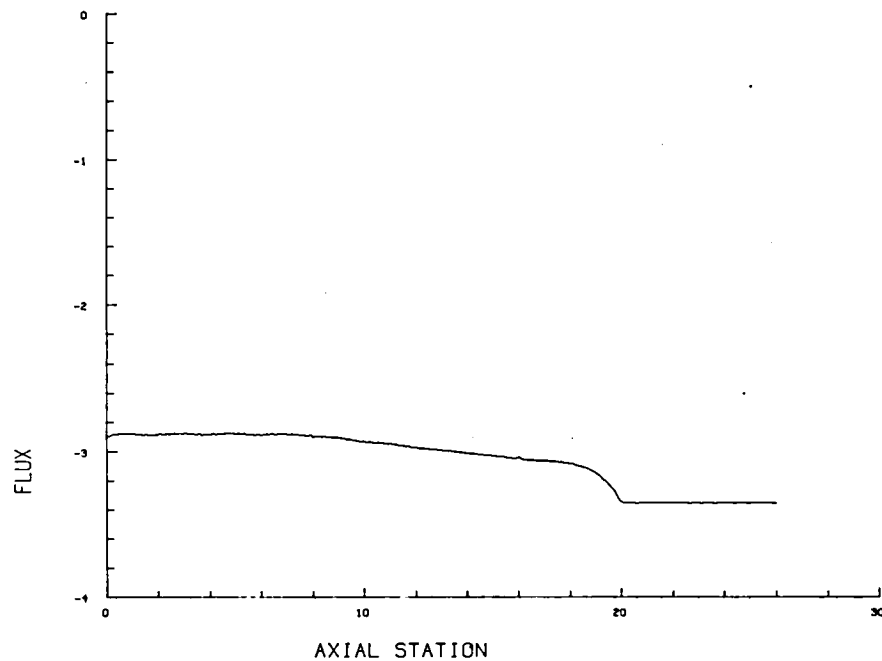


Figure A10. Plot of Acoustic Flux Across Sections
Normal to Centerline at 160Hz for Figure 9(d)

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16. Abstract The NASA LaRC 4 x 7 Meter Wind Tunnel is an existing facility specially designed for powered low speed (V/STOL) testing of large scale fixed wing and rotorcraft models. The subject under consideration in this report is the enhancement of the facility for scale model acoustic testing. A substantial amount of work had been performed prior to this study. This work is critically reviewed and comparisons are drawn with a similar wind tunnel (the DNW Facility in the Netherlands). Discrepancies observed in the comparison stimulated a theoretical investigation using the acoustic finite element ADAM System, of the ways in which noise propagating around the tunnel circuit radiates into the open test section. This investigation clarifies the reasons for the discrepancies noted above, and assists in the selection of acoustic treatment options for the facility.					
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